DOCKETED

Docket Number:	16-BSTD-06
Project Title:	Updates to the 2019 Time Dependent Valuation of Energy
TN #:	211717
Document Title:	SolarCity Comments - Updates to 2019 TDV
Description:	N/A
Filer:	System
Organization:	SolarCity/Damon Franz
Submitter Role:	Public
Submission Date:	6/3/2016 1:43:57 PM
Docketed Date:	6/3/2016

Comment Received From: Damon Franz
Submitted On: 6/3/2016
Docket Number: 16-BSTD-06

SolarCity Comments - Updates to 2019 TDV

Please find attached SolarCity's comments on the updates to the 2019 TDV metric.

Additional submitted attachment is included below.

SolarCity

June 3, 2016

Commissioner Andrew McAllister
California Department of Energy
Dockets Office
Re: Docket No. 16-BSTD-06
1516 Ninth Street
Sacramento, CA 958 14-55 12

RE: Updates to the 2019 Time Dependent Valuation of Energy

Dear Commissioner McAllister,

SolarCity respectfully submits the following comments on the 2019 update to the time dependent valuation (TDV) for Title 24 building standards in response to the May 12, 2016 workshop.

Background

SolarCity is a full service solar power provider for homeowners and businesses – a single source for engineering, design, installation, monitoring, and support. As of March 31, 2016, the company had more than 6,000 California employees, based at more than 40 facilities around the state and had installed solar energy systems for over 260,000 customers nationwide.

In addition to rooftop solar, SolarCity develops and deploys other non-solar distributed energy resources (DER) for both residential and commercial applications. Specifically, SolarCity offers smart thermostats, smart electric water heaters, and battery energy storage systems to help customers manage their energy use. Accordingly, SolarCity has a strong interest in the update of the 2019 Title 24 building efficiency standards to reflect the state's Zero Net Energy (ZNE) goals.

Overall Comments

SolarCity commends the leadership of the California Energy Commission (CEC) and the Energy and Environmental Economics (E3) staff in updating the TDV values to capture the traditional costs of energy delivery on the transmission and distribution (T&D) system. Nevertheless, applying the TDV values as currently proposed by staff to calculate the energy budget for buildings and valuing the energy performance trade-offs made in building designs does not sufficiently address the value of solar photovoltaics (PV) on the grid especially when PV systems are combined with battery storage and/or smart load control devices.

We therefore appreciate the opportunity to comment in particular on the opportunities for accurately valuing energy storage and load control devices using the TDV metric in order to meet California ZNE goals for 2020, Renewable Portfolio Standard (RPS) targets, and the challenges of high penetration of renewable energy on the state's transmission and distribution grid.

Solar PV Paired with Energy Storage and Load Control Devices

Energy storage allows energy from onsite renewables to be dispatched at times of greatest value for both the consumer and the grid. As a result, energy storage helps to flatten demand and supply peaks on the electric grid by balancing the difference in building load and onsite renewable generation. Because electricity cost is correlated with emissions, using batteries to store energy when it is inexpensive for use when it is more costly can significantly reduce emissions. This value is amplified when pairing storage with solar systems.

Energy storage coupled with PV is a fully dispatchable carbon free solution that will be critical to meeting the state's ZNE goals and overall greenhouse gas emissions (GHG) targets. Solar PV paired with storage enables the generation and storage of renewable energy during the day, the discharge of the battery storage system when energy is more expensive during peak periods, and the ability to participate in utility grid services or potentially wholesale markets to maximize benefits for customers and the grid.

Load control allows for appliance loads to be managed in a way that reduces electricity consumption during periods of peak grid demand and shifts the load to periods with excess renewable generation or low grid power costs. As a result, more electricity is used during low electricity cost and low emissions periods while avoiding periods of high electricity cost and high emissions. These strategies can be extended beyond the usual critical or high grid load demand response (DR) events and applied on a daily basis, which helps to reliably flatten demand and supply peaks on the electric grid. Specifically, combining PV with smart electric water heaters offers a solution in which electric consumption from water heating occurs during the day and is stored for later consumption by the occupants.

Issues with TDV metric for Energy Storage and Load Control Devices

As referenced in SolarCity's previous comments on TDV for ZNE, we believe that the update of the TDV methodology should include an analysis to determine the value of energy storage and load control technologies.[1] Currently, the value of energy storage and load control capabilities is not captured in the TDV methodology.

When solar PV systems are combined with battery storage the PV energy *delivered* to the home loads or grid will be at a different time than when the energy is *generated*. Therefore applying the TDV energy budget credit to PV energy as though it is delivered during the solar day does not accurately capture its true time dependent value. In reality the energy generated by the PV system should be credited at the TDV value in which the energy is *delivered* by discharging the battery to power the home or grid. By not accounting for when PV power is delivered, the value of PV energy is undervalued in the current TDV methodology by applying lower daytime TDV $/MWh credits instead of peak TDV $/MWh credits.

When solar PV systems are combined with smart load control such as electric water heaters the water heaters are not consuming electricity during the hours that the current code assumes as outlined by the CEC hourly water heating schedules listed in the ACM reference manual[2]. Instead, water is heated during the day using solar energy and stored for later use. In this example, the current TDV methodology is applying peak TDV values to electric water heating consumption even though water heating would only occur during the day and be heated using solar energy.

Potential Solutions for Valuation of Energy Storage and Load Control Devices in TDV Metric

In the comments above, we point out several issues with the current TDV methodology in how it does not accurately value storage and load control devices paired with solar PV. Fortunately there are several potential near term solutions the CEC should consider. First is applying TDV values to PV combined with

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[1] SolarCity Comments on 2015 Integrated Energy Policy Report, Nov 10, 2015; *available at* http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-01/TN206576_20151110T155316_Damon_Franz_Comments_SolarCity_Comments__2015_Draft_IEPR.pdf

[2] 2016 Residential Alternative Calculation Method Reference Manual Appendix B http://www.energy.ca.gov/2015publications/CEC-400-2015-024/CEC-400-2015-024-CMF.pdf

battery storage and PV combined with smart water heaters that accurately reflect the hours in which PV is actually delivered and when water heating demand actually occurs. To do this, it is critical to consider the operation and performance of these devices and apply an expected battery discharge output or water heating schedule as applicable. This requires the CEC Title 24 building code to address the performance of equipment after the time of installation instead of basing the energy budget of a home on static day-1 design assumptions or nameplate specifications. Therefore, we recommend that the Title 24 building standards code take into account the actual performance of systems.

Additionally, SolarCity recognizes that changing the valuation of PV must also come with some type of verification mechanism. It is important that the proposed devices actually conform to the expected discharge and water heating schedules. A number of options should be explored to ensure that the TDV values applied in the design phase accurately represent how the systems perform after installation. Some examples to consider include:

- Homes wishing to take advantage of increased benefits from PV plus battery systems or PV plus load control systems could be required to enroll in Time of Use (TOU) rates to economically incentivize discharging batteries during peak periods or avoiding electric water heating during peak periods. California investor owned utilities (IOUs) (PG&E, SCE, SDG&E) are already in the process of requiring new solar customers to enroll in TOU rates once specific renewable capacity thresholds are met. Thresholds are expected to be met in all three utilities' territories by the end of 2017. This same approach could be applied in all California utilities' territories, including publicly owned utilities (POUs), as a mechanism to incentivize adoption and TDV appropriate performance of energy storage and load control devices.
- The software that is used to control the batteries and water heaters could be tested against an agreed upon standard that ensures operation that aligns with alternate TDV valuation methodologies.

While these are two potential solutions, there are likely several other options that should be evaluated beyond what we have considered here.

Importance of Accurate TDV Valuation for Energy Storage and Load Control

Looking beyond the near term, accurately valuing TDV for energy storage and load control can also have a critical impact to meeting the state's clean energy policy goals and addressing grid needs in the next 5 to 10 years.

Applying appropriate TDV credits within the CEC building code will incentivize builders and homeowners to adopt energy storage and load control devices along with PV. Doing so will slow down, or help avoid altogether, reaching renewable hosting capacity limits on many utility distribution circuits. Energy storage and load control limits how much PV each house exports onto the grid when properly controlled to do so. As a result there is less impact to the transmission and distribution system which overall decreases the mitigation requirements and costs due to renewables on a per capita basis. By encouraging the adoption of energy storage and load control devices now the state can avoid the challenges of interconnecting renewable energy on high penetration circuits in the future, as is currently experienced by states like Hawaii.

California has established a goal of having all new residential construction be ZNE by 2020. In order to achieve true ZNE status, many homes will need to utilize very large solar PV arrays. Doing so will result in significant energy being exported back onto the distribution grid for nearly every ZNE home or community.

Similarly, the California's 2030 RPS targets established by SB 350 will result in increasing renewables interconnected to the grid at the transmission level, further contributing to integration challenges at the distribution level. . Without energy storage and load control, the state will face increasing challenges interconnecting more renewables onto the grid and risk not meeting RPS targets.

Although the grid can accommodate significantly more PV than what exists today, PV systems with large amounts of energy export will limit the PV capacity able to interconnect in the future. As California moves toward high adoption of renewables and ZNE homes, the electric grid and energy use will need to adapt to accommodate intermittent renewable generation. This is done most efficiently and with least environmental impact if the PV systems and ZNE homes themselves are incentivized to adopt energy storage or load control. Ignoring these conditions today would create a scenario where future installations are required to adopt these technologies in order to interconnect onto the T&D system. Incentivizing this technology now acknowledges the future need to adapt and will enable higher penetrations in the future.

Properly valuing PV with energy storage and load control through the TDV credits in the CEC's building code aligns with broader California energy policy putting the state in a better position to reach ZNE goals and RPS targets, and helps meet the challenges of high penetration of renewable energy on the T&D system. The 2019 update to the TDV methodology and the Title 24 building standards provides a critical junction for California to be on track to meet its goals and targets.

Conclusion

It is important that the updates to the 2019 TDV calculation accurately value energy storage and load control devices. For solar PV plus batteries the TDV value should reflect the peak TDV periods when PV energy would be delivered to the home or grid. The TDV value for load control technologies, including electric water heaters, should reflect the low TDV period when PV is heating water during the daytime and not during peak periods.

SolarCity thanks the CEC for the opportunity to comment on the update of the 2019 TDV calculation. We look forward to providing any additional details that may be helpful as you evaluate how the state can reach its 2020 ZNE goals in relation to the TDV methodologies currently proposed for the 2019 building code.

Respectfully submitted,

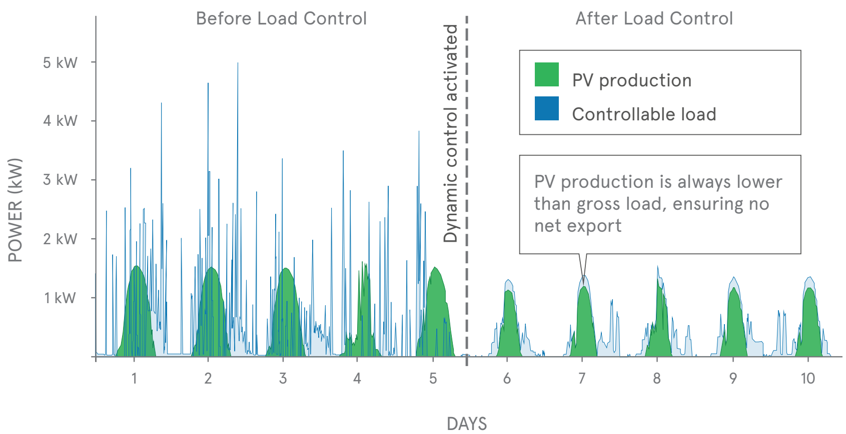
Damon Franz
Director, Policy and Electricity Markets
SolarCity

SolarCity Grid Interactive Water Heater

Respond to on-site and grid-level power conditions with dispatchable water heaters.

The Grid Interactive Water Heater provides up to 4.5 kW of controllable load by adjusting real-time power consumption. It increases the water temperature in the tank up to 170°F, acting as a thermal storage device with 7 kWh–12 kWh of daily storage capacity in a typical California home. Water heated by solar during the day is stored for later use—giving customers continuous access to hot water without impacting their comfort or behavior.

The water heater dynamically responds to the variability of customer loads and solar generation to maintain a predictable whole-home net load.



Services

Our distributed control platform allows you to control the water heaters through a front-end web interface or back-end software integration. Grid operators can dispatch them as a single resource aggregated at configurable points on the grid, such as a sub-LAP, substation or feeder.

Customer services

- Meet hot water electrical demand primarily through solar energy.
- Absorb on-site solar generation to avoid net energy export.
- Avoid peak Time-of-Use energy charges, where applicable.
- Participate in real-time demand response events.

Aggregated grid-level services

- Offer scheduled or real-time capacity / demand reduction.
- Fixed load shifting from high-demand to low-demand periods.
- Frequency regulation via Automated Generation Control signal following.
- Provide spinning or non-spinning regulating reserves.

Key Benefits

- Unlock up to 20 GW of additional solar-hosting capacity on the California grid through statewide adoption.
- Reduce natural gas pipeline utilization by over 480 MMcf per day through statewide adoption.
- Avoid ~1.0 metric ton of CO_2 emissions per year per water heater when powered by solar versus natural gas.
- Improve heating efficiency by ~50% compared to typical natural gas water heaters.
- Features built-in measurement and verification (M&V) metering.
- Improve safety by eliminating an in-home combustion appliance and reducing reliance on natural gas infrastructure.

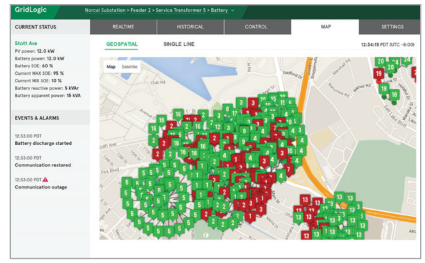
At a glance

- Capacity of 52, 80 or 100 gallons
- ~7-12 kWh of daily solar storage
- 0 kW–4.5 kW controllable load
- 45 W incremental load adjustment
- Fully UL listed

Technology

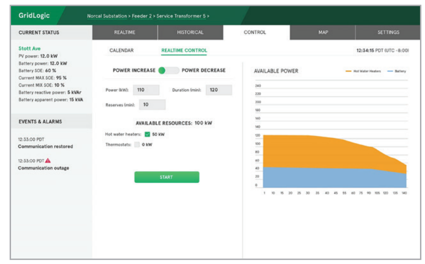
Water heater

- Compares to a traditional electric water heater with added dynamic controls.
- Connects to existing plumbing with very little modification needed.
- Heats water inside the tank with electric resistance heating elements.
- Offers an adjustable water temperature limit through an in-line mixing valve.



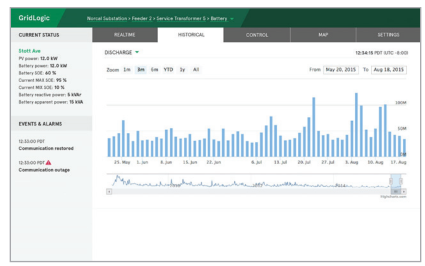
Controller

- Receives control signals wirelessly via an on-site gateway or remote server.
- Connects to a typical 30 Amp electric circuit.
- Varies power demand from 0 kW to 4.5 kW by modifying the electric current drawn by the water heater.
- Automatically maintains a minimum temperature for uninterrupted hot water.
- Enables revenue-grade measurement and verification via onboard energy, power and temperature monitoring.
- Reverts to a configurable Comfort Assurance mode if communication is lost.



SolarCity GridLogic software

- Adjust the water heater to meet a configurable set of conditions or services.
- Send control signals to manage individual or aggregated water heaters.
- Manage state-of-energy by monitoring energy, power and temperature.
- Responds in less than 4 seconds.



Controller	52 Gallon 1302203	80 Gallon 1302205	100 Gallon 130220#
Manufacturer/Make	Steffes / GETS GEN 2		
Model	IWHC Control (HTP 52G Kit)	IWHC Control (HTP 80G Kit)	IWHC Control (HTP 100G Kit)
GETS System Tank Size in US Gallons	52	80	100
Height x Width x Depth (inches)	7.0 x 8.5 x 3.5		
Board Version	2016		
USB Port Included	Yes		
Internet Connectivity	Ethernet 802.3 10/100Mbps RJ-45 connection with option for Wi-Fi bridge		
Line Power	80~260VAC		
Current	0.2 amps		
Max Amperage (amps)	23.0		
Enclosure Type	Indoor		
UL Listing	UL Cat. PAZX (load management)		
Warranty	2 yrs. from purchase or 3 yrs. from manufacture date		

Water Heater	52 Gallon 1302203	80 Gallon 1302205	100 Gallon 130220#
Manufacturer/Make	Heat Transfer Products / Everlast Water Heater		
Model#	EVR052C2X045	EVC080C2X045	EVC100C2X045
Capacity in US Gallons	52.0	80.0	100.0
Type	Commercial	Commercial	Commercial
Height (inches)	66.75	69.00	61.00
Diameter (inches)	19.50	23.25	27.00
Depth - including controller (inches)	23.00	26.75	30.50
Weight empty (lbs.)	118.0	151.0	206.0
Efficiency	0.94 Energy Factor	98% Thermal Efficiency	98% Thermal Efficiency
Recovery @ 90F Rise (gallons)	20.0	20.0	21.0
First Hour Delivery Rating (gallons)	75.0	84.0	87.0
Upper/Lower Element Wattage:	4,500 / 4,500 (non-simultaneous charge)		
Voltage:	240.0	240.0	240.0
Minimum/Maximum delivered temperature F	120.0/179.9	120.0/179.9	120.0/179.9
Maximum delivered temperature F	200.0	200.0	200.0
UL Listing	UL174	UL1453	UL1453
AHRI Reference Number	8005615	DOE Grid Enabled	DOE Grid Enabled
NAECA III	Yes	DOE Grid Enabled	DOE Grid Enabled
CA Appliance EE DB Title 20 compliant	11/6/2015	DOE Grid Enabled	DOE Grid Enabled
Warranty tank/parts	10 yrs./1 yr.		